

REMARKS

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

Claims 7, 8, and 12-15 have been canceled.

This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 1-6, 9-11, and 16-23 are now pending in this application. Claims 16, 18, and 20 have been provisionally withdrawn from consideration.

Claim Objections

Claims 1, 2, 15, and 17 are objected to for containing informalities. Claims 1, 2, and 17 have been amended to overcome these objections. Claim 15 has been canceled. Withdrawal of these objections is respectfully requested.

Rejections under 35 U.S.C. § 103

Claims 1, 3, 5, 7, 9, 11, 19, and 21-23 are rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 2002-344017 (hereafter "Konno et al.") in view of U.S. Pub. No. 2002/0104997 (hereafter "Kuo et al.") and U.S. Pub. No. 2002/0137243 (hereafter "Chen et al."). This rejection is respectfully traversed.

Amended claim 1 recites a light emitting diode, comprising: a semiconductor substrate; a light-emitting region including an active layer provided between a first conductivity type cladding layer formed over the semiconductor substrate and a second conductivity type cladding layer; a transparent conductive film made of a metal oxide and located over the light-emitting region; a first electrode formed on the upper side of the transparent conductive film; a second electrode formed on the whole or a part of the bottom

of the semiconductor substrate; a direct transition AlGaAs layer made of $\text{Al}_x\text{Ga}_{1-x}\text{As}$ ($0.01 \leq x \leq 0.43$) as a preventing layer for preventing exfoliation of the transparent conductive film, the AlGaAs layer being located between the second conductivity type cladding layer and the transparent conductive film, the AlGaAs layer being added with at least one of Zn, Be and Mg, and C, the AlGaAs layer having a carrier concentration of $1 \times 10^{19} \text{ cm}^{-3}$ or higher; an undoped layer or a low carrier concentration layer formed between the active layer and the second conductivity type cladding layer, wherein the undoped layer or the low carrier concentration layer is a layer other than the active layer and comprises a bandgap greater than the active layer; a second conductivity type contact layer formed between the second conductivity type cladding layer and the AlGaAs layer; and an undoped layer inserted into the second conductivity type contact layer. Claims 3, 5, 9, 11, 19, and 21-23 depend from claim 1.

A light emitting diode (LED), as recited in amended claim 1, can advantageously provide a 3.12 mW output, even when the thickness of an AlGaAs layer is 5 nm, as shown in Table 1 of the specification. One can advantageously provide a light emitting diode, as recited in claim 1, that uses a low operating voltage and is produced at low cost and with a good yield. Reliability tests at 55 °C and 50 mA electric condition with respect to an LED element, which is used for an LED before being sealed with a resin, confirm that an LED element exhibits such a high level of reliability that all relative outputs (such as emission output before electric conduction / emission output after electric conduction) are at 90% or more after 24 hours of electric conduction, as discussed on page 23, lines 5-17, page 12, line 25, to page 13, line 3, of the specification. Because the tunneling effect increases, a resistance in the transparent conductive film, the direct transition AlGaAs layer, and the second conductivity type cladding layer decreases so that a forward operative voltage decreases. The presence of aluminum in the direct transition AlGaAs layer provides good adherence with the transparent conductive film, as discussed on page 13, lines 3-4, of the specification. Furthermore, a direct transition AlGaAs layer has a film resistance that is far lower than that of an indirect transition AlGaAs layer because the latter comprises a high aluminum content that causes the layer to be easily oxidized, or to easily incorporate oxygen therein, which causes a high level of oxygen and an increase in the resistance of the layer.

Konno et al. discloses a semiconductor light emitting element that includes a transparent conductive layer 7, a compound semiconductor layer 6, a second conductivity clad layer 4, an active layer 3, a first conductivity clad layer 2, and a first conductivity substrate 1. See abstract of Konno et al. Konno et al. discloses that the compound semiconductor layer 6 can be a ternary compound, such as AlGaAs, and can have a molar ratio of Ga that is adjusted to ≤ 0.2 . See abstract of Konno et al.

However, Konno et al. does not disclose or suggest “a direct transition AlGaAs layer made of $\text{Al}_x\text{Ga}_{1-x}\text{As}$ ($0.01 \leq x \leq 0.43$) as a preventing layer for preventing exfoliation of the transparent conductive film, the AlGaAs layer being located between the second conductivity type cladding layer and the transparent conductive film, the AlGaAs layer being added with at least one of Zn, Be and Mg, and C, the AlGaAs layer having a carrier concentration of $1 \times 10^{19} \text{ cm}^{-3}$ or higher,” as recited in claim 1.

Kuo et al. discloses a semiconductor light emitting diode that includes a multiple-quantum well 212 as an active layer between n- and p-type cladding layers. See paragraph 0038 of Kuo et al. However, Kuo et al. does not disclose or suggest “a direct transition AlGaAs layer made of $\text{Al}_x\text{Ga}_{1-x}\text{As}$ ($0.01 \leq x \leq 0.43$) as a preventing layer for preventing exfoliation of the transparent conductive film, the AlGaAs layer being located between the second conductivity type cladding layer and the transparent conductive film, the AlGaAs layer being added with at least one of Zn, Be and Mg, and C, the AlGaAs layer having a carrier concentration of $1 \times 10^{19} \text{ cm}^{-3}$ or higher,” as recited in claim 1.

Chen et al. discloses a semiconductor device that includes a thick metal layer 70, a p-type electrode 68, an optically transparent layer 66, a current blocking layer 79 formed in the optically transparent layer 66, an optical extraction layer 64, and an n-type optically transparent AlGaAs window layer 62. See Chen et al. at paragraphs 0029 and 0038. However, Chen et al. does not disclose or suggest “a direct transition AlGaAs layer made of $\text{Al}_x\text{Ga}_{1-x}\text{As}$ ($0.01 \leq x \leq 0.43$) as a preventing layer for preventing exfoliation of the transparent conductive film, the AlGaAs layer being located between the second conductivity type cladding layer and the transparent conductive film, the AlGaAs layer being added with

at least one of Zn, Be and Mg, and C, the AlGaAs layer having a carrier concentration of $1 \times 10^{19} \text{ cm}^{-3}$ or higher,” as recited in claim 1.

It would not have been obvious to one of ordinary skill in the art to combine the teachings of Konno et al., Kuo et al., and Chen et al. to provide all of the features recited in claim 1. A basic requirement of a *prima facie* case of obviousness is that a prior art reference, or prior art references when combined, must teach or suggest all of the claim limitations. See M.P.E.P. §§ 2143, 2143.03. The Office has not set forth a *prima facie* case of obviousness because Konno et al., Kuo et al., and Chen et al., alone or in combination, do not disclose or suggest all of the features recited in amended claim 1. Furthermore, a *prima facie* case of obviousness cannot be made on the basis of Konno et al., Kuo et al., and Chen et al. because these references do not disclose or suggest all of the features of amended claim 1.

For at least the reasons discussed above, withdrawal of this rejection is respectfully requested.

Claims 2, 4, 6, 8, and 10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Konno et al., Kuo et al., and Chen et al., as applied to claim 1, and further in view of U.S. Pub. No. 2005/0095768 (hereafter “Tsuda et al.”). This rejection is respectfully traversed. Tsuda et al. fails to remedy the deficiencies of Konno et al., Kuo et al., and Chen et al. discussed above in regard to independent claim 1, from which these claims depend.

The Office asserts on page 9 of the Office Action that it would have been obvious to combine the teachings of Tsuda et al. with the combination of Konno et al., Kuo et al., and Chen et al. to provide a preventing layer with a carrier concentration of $1 \times 10^{19} \text{ cm}^{-3}$ or higher. However, Tsuda et al. discloses a carrier concentration of $6 \times 10^{19} \text{ cm}^{-3}$ for p-type $\text{Al}_{0.1}\text{Ga}_{0.9}\text{N}$ and a carrier concentration of $1 \times 10^{20} \text{ cm}^{-3}$ for p-type GaN. See Tsuda et al. at paragraph 0143. Therefore, it would not have been obvious to combine Konno et al., Kuo et al., Chen et al., and Tsuda et al. to provide a direct transition AlGaAs layer with a carrier concentration of $1 \times 10^{19} \text{ cm}^{-3}$ or higher, as recited in claim 1, because Tsuda et al., alone or in combination, does not disclose or suggest a direction transition AlGaAs layer with a carrier concentration of $1 \times 10^{19} \text{ cm}^{-3}$ or higher, as recited in claim 1.

For at least the reasons discussed above, withdrawal of this rejection is respectfully requested.

Claim 13 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Konno et al., Kuo et al., and Chen et al., as applied to claim 11, and further in view of Tsuda et al. This rejection is respectfully traversed. Tsuda et al. fails to remedy the deficiencies of Konno et al., Kuo et al., and Chen et al. discussed above in regard to independent claim 1, from which claim 13 depends. Withdrawal of this rejection is respectfully requested.

Claims 15 and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Konno et al., Kuo et al., and Chen et al., as applied to claim 1, and further in view of U.S. Patent No. 6,495,862 (hereafter "Okazaki et al."). This rejection is respectfully traversed. Okazaki et al. fails to remedy the deficiencies of Konno et al., Kuo et al., and Chen et al. discussed above in regard to independent claim 1, from which claims 15 and 17 depend. Withdrawal of this rejection is respectfully requested.

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check or credit card payment form being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicants hereby petition for

such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date

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By



FOLEY & LARDNER LLP

Customer Number: 22428

Telephone: (202) 672-5426

Facsimile: (202) 672-5399

Glenn Law

Attorney for Applicant

Registration No. 34,371